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Newsletter #4 Topics:
PICkit 2 Logic Analyzer Tool
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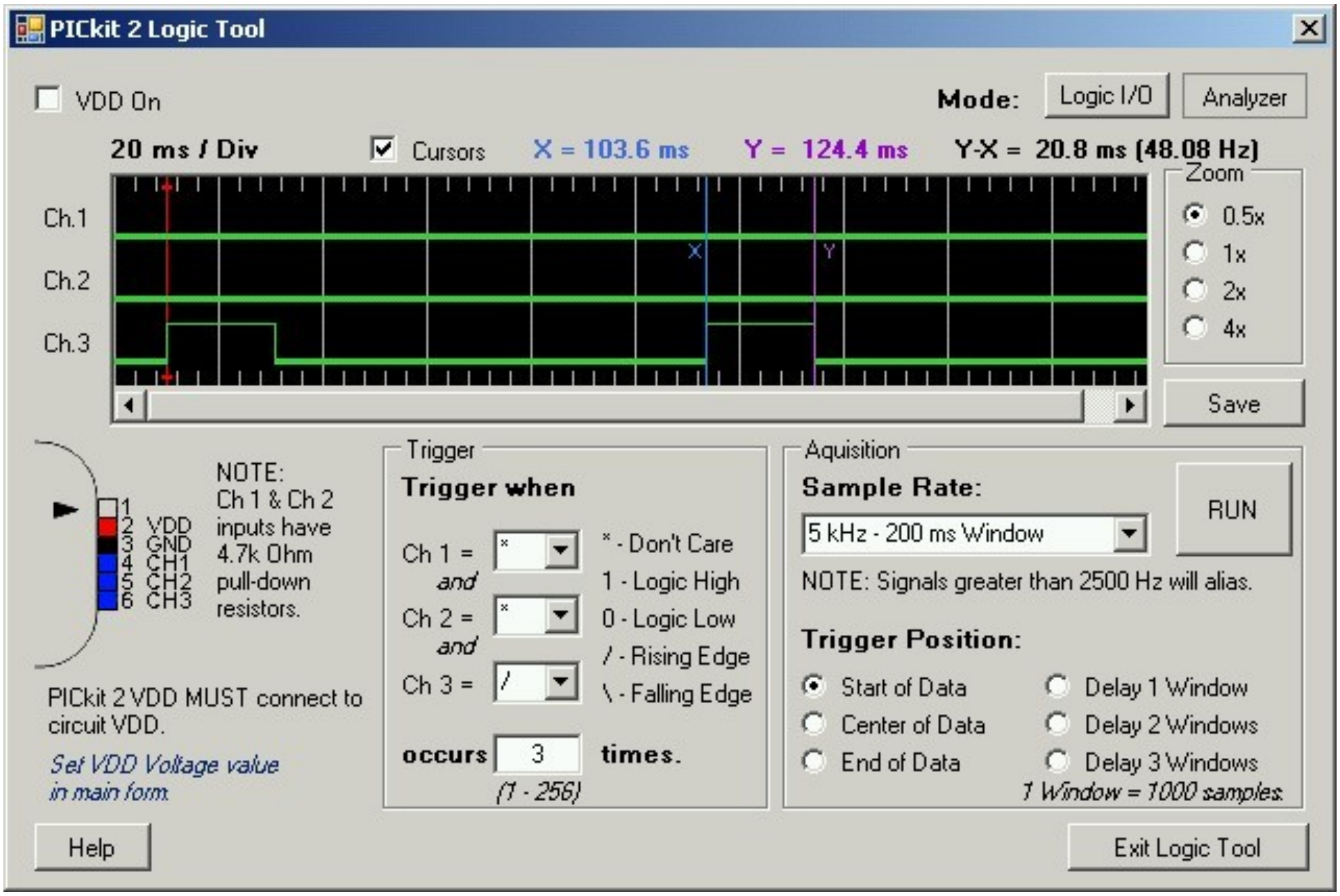
PICkit 2 Logic Analyzer

In the last CHIPs Newsletter I described the PICkit 2's built-in UART Tool. Well there is another great tool included called the Logic Tool. Both these tools are part of the PICkit 2 Stand Alone application which is currently at version level 2.61. The PICKit 2 can run in Microchip's MPLAB IDE or from a DOS command line interface or from this Stand Alone PICkit 2 application. This interface is very popular with a lot of PICkit 2 users and is still not available for the PICkit 3 (though I'm told its being worked on). The Logic Tool is a simple three-channel logic analyzer. A logic analyzer is similar to an oscilloscope, except that it just shows logic-level square-wave signals not multiple voltage level signals or rising/falling analog voltages. For many PIC applications this can be very handy. If you don't have an oscilloscope then this is a very low cost alternative to see if you are getting the digital signals you expect.

The Logic tool has it's own operations manual so you won't find it in the PICkit 2 user guide. You can download it from the Microchip website at the link below.

http://ww1.microchip.com/downloads/en/DeviceDoc/PICkit%202%20Logic%20Tool%20User%20Guide.pdf

Figure 1 below shows a screen capture of the Logic Tool running with a square wave captured on channel 3. The pinout for the logic analyzer is shown in the lower left corner of the screen. You can see there are three channels, power and ground. The logic analyzer needs power and ground connected to your circuit to work. On an actual Microchip PICkit 2, Channels 1 and 2 have 4.7k resistors to ground internal to the programmer. Some PICkit 2 clones leave these off. They are included to help make debugging with PICkit 2 more stable. Some PICkit 2 clones don't have a 6th pin on the connector so you only get two channels. The CHIPAXE programmer I use in my latest book "Programming PICs in BASIC" only has two channels.



PICkit 2 Logic Tool

□ VDD On

Mode: Logic I/O | Analyzer

20 ms / Div ☑ Cursors X = 103.6 ms Y = 124.4 ms Y-X = 20.8 ms (48.08 Hz)

Zoom: ● 0.5x ○ 1x ○ 2x ○ 4x

NOTE: Ch 1 & Ch 2 inputs have 4.7k Ohm pull-down resistors.

PICkit 2 VDD MUST connect to circuit VDD.

Set VDD Voltage value in main form.

Trigger

Trigger when

Ch 1 = * *and*
Ch 2 = * *and*
Ch 3 = /

* - Don't Care
1 - Logic High
0 - Logic Low
/ - Rising Edge
\ - Falling Edge

occurs 3 times.
(1 - 256)

Aquisition

Sample Rate: 5 kHz - 200 ms Window

NOTE: Signals greater than 2500 Hz will alias.

Trigger Position:

● Start of Data ○ Delay 1 Window
○ Center of Data ○ Delay 2 Windows
○ End of Data ○ Delay 3 Windows

1 Window = 1000 samples

Figure 1: PICkit 2 Logic Tool

One of the nicer features are the cursors. You can see the blue x line and the purple y line surrounding the pulse on channel 3. Way to the left is the red trigger line showing that the signal was captured on the rising edge. Above the signal screen are the times associated with those cursors relative to the trigger line and then a difference calculation that shows us the pulse width of this signal. This can be very handy for testing a PWM pulse width. You can change the trigger settings in the Trigger section of the screen. I had it set here to trigger on the rising edge of CH 3 and wait for 3 rising edges. The acquisition area allows you to set how much of the signal you see on the screen. If you needed to zoom in later the zoom area to the right allows you to change the view. Finally the save button on the lower right side of the signal screen will save the signal screen in a .bmp file. This can be handy for writing up a report.

The Logic Tool also has a Logic I/O mode that acts like a logic probe just showing if a signal on the various channels is high or low. You can also make it into an input mode so you can change a port pin from high to low like a switch but controlled by the Logic Tool. I don't use this much but it is described well in the Logic Tool manual.

Overall this tool is a very handy feature and just another reason to have a couple PICkit 2's lying around your bench.

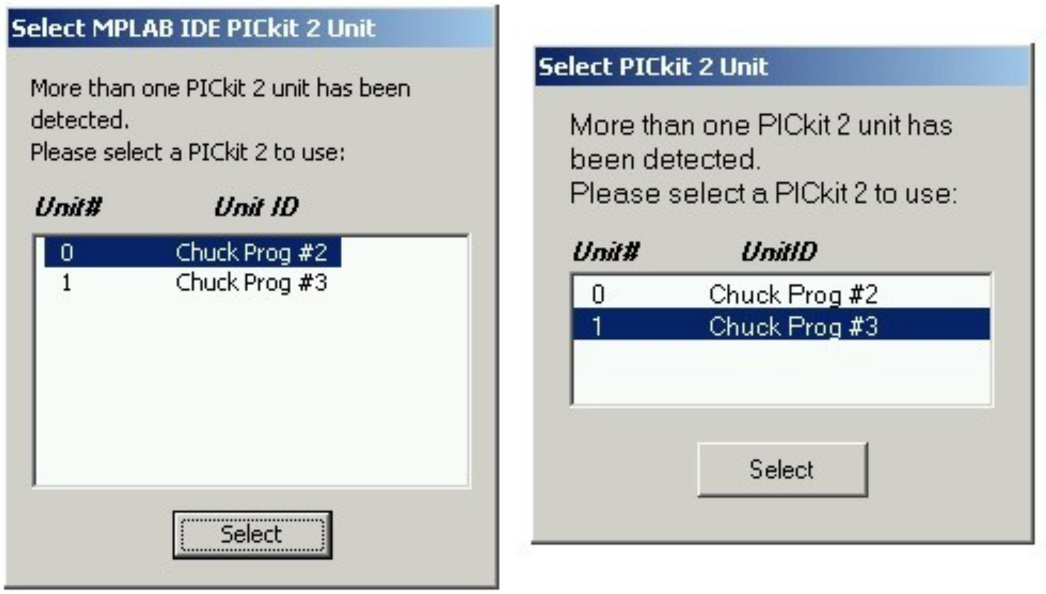
Multiple PICkit 2's

If you have multiple PICkit 2's and want to use one from MPLAB and one from the stand alone software you may wonder how does the computer know which is which.

When you open the Stand Alone PICkit 2 software with two PICkit 2's connected, the screen will ask which PICkit 2 you want to use, as seen on the right side of Figure 2. I have two PICkit 2s connected to my PC. Notice that the PICkit 2s have unique names in the figure. You can give each PICkit 2 a unique name through the "Calibrate VDD and Set Unit ID..." selection under the Tools menu of the Stand Alone application. This is the same menu where you select the UART or Logic Tool. This Unit ID name will then get stored in the internal PICkit 2 memory so it will stay with the unit. I often put a small piece of tape with the number on the PICkit 2s, so that I can keep them straight visually.

To use multiple PICkit 2s with the MPLAB IDE, you need MPLAB software version 8.15 or later. When you select PICkit 2 from the programmer menu in the MPLAB IDE it will ask you which PICkit 2 it should work with. That window is shown on the left in Figure 2. Because you can have multiple stand alone versions running with multiple PICkit 2 programmers connected, I can easily have three PICkit 2s for many projects. One is used for programming and debugging from the MPLAB IDE, one for UART communication and one for a Logic Tool. You can buy three of these for far less than the cost of an oscilloscope. If you need to monitor more than 3 signals, then you can use even more PICkit 2s in Logic Tool mode giving you more channels though on separate screens.

If you didn't know about all this then my newsletter hopefully showed you another way to get the most out of your time programming Microchip PICs. You could even use this tool with a non-micro setup. For example, lets say you were teaching a group of students how to build a 555 timer project that produced a variable pulse width (though why not just teach them using an 8 pin PIC) you can use the logic analyzer to show them the signal.



Select MPLAB IDE PICkit 2 Unit

More than one PICkit 2 unit has been detected.
Please select a PICkit 2 to use:

Unit#	Unit ID
0	Chuck Prog #2
1	Chuck Prog #3

Select PICkit 2 Unit

More than one PICkit 2 unit has been detected.
Please select a PICkit 2 to use:

Unit#	UnitID
0	Chuck Prog #2
1	Chuck Prog #3

Figure 2: PICkit 2 Selector Windows

PIC16F886

The 28 and 40-pin packages have long been my most favorite parts to develop with. In the past, I've always used the PIC16F876A (28-pin package) and PIC16F877A (40-pin package) devices, as they have all the features and I/O I typically need, plus they provide more memory space. These parts are also supported by the sample version of PICBASIC PRO, and the PIC16F877A is supported by many other compiler sample versions. I still recommend you keep some of these devices in your lab, but an upgrade to the family was released a couple years ago, and my two recommendations are the PIC16F886 (28-pin package) and the PIC16F887 (40-pin package). They add a few more features the PIC16F87XA parts don't offer. The biggest advantage is the internal oscillator. The PIC16F87xA parts require an external oscillator, but if all you need is an external crystal of 8 MHz or less, then the PIC16F88X parts have an internal 8 Mhz oscillator to make it easier to use. The 28 pin 16F886 is really my favorite. Its small enough to fit in most designs but offers all the I/O and features I need. These parts are also supported by the PICBASIC PRO sample version.

This part is pin compatible with the 28 pin 16F87x so any board you have that used a PIC16F876A will work with this part. I plan to use this part in future books and am considering a new mini book series on using this part with a new development board being developed at www.CHIPAXE.com. Stay tuned for that one. The chips features are highlighted below.

PIC16F886 Features:

14 Kbytes/8 K-word program memory (14-bit address)
368 Bytes RAM
USART
11 10-bit ADCs
3 timers
1 Capture/Compare/PWM peripheral
1 ECCP peripheral
2 comparators
256 bytes of EEPROM
Internal oscillator up to 8 MHz
Self-Write Memory

One of the great advantages to this part is the ability to debug in circuit without any adapter. You can debug your code within Microchip's MPLAB using the PICkit 2 and the programming connections. I often develop with this part first and then later move to a smaller part after I've got the code running the way I want. This part also has the ability to program through a bootloader. There are many people out there who prefer to program without a PIC programmer and instead like to have the part program itself via software which is what a bootloader does. I think bootloaders make things a little more confusing for the beginner and with a PICkit 2 programmer relatively cheap I recommend beginners stick with a programmer. It is nice to know though that the option is there with these chips.

External Oscillator Modes

One area I've received a few emails on concerns the external oscillator configuration settings on the various PICs. There is typically an LP, XT, HS and EC mode to select from. It can be confusing to a beginner which one to use. The data sheet for the part should always be your first point of reference but I thought I would cover the basics here. All these settings just control the internal circuitry of the PIC that drives the external crystal or resonator. A crystal or resonator needs an initial drive current to get it to start oscillating. Getting that current correct is critical especially if you want to run at extreme temperatures. Here are the proper settings based on the oscillator speed.

LP - This mode is selected typically for Low Power (LP) and it is designed to drive a low frequency crystal such as a 32khz clock crystal.

XP - This mode is selected for frequencies of 1 Mhz to 4 Mhz.

HS - This mode is for any speed beyond 4 Mhz.

EC - This mode is for using an external clock oscillator module. You can also use this setting to drive a PIC from an external clock signal the was generated by another PIC.

Note: Also remember that the eight bit PICs (10F, 12F, 16F and 18F) all divide the oscillator by four before using it as the system clock. That means if you need the timers to run off a 4 Mhz internal clock then you need an external 16 Mhz crystal connected. Many of the 18F parts have the ability to use a PLL (Phase Lock Loop) to eliminate this divide by four but the PLL can only work up to 10 Mhz input. A 10 Mhz crytal on a 18F using the PLL will give you an internal clock of 10 Mhz. That is one of the advantages to the 18F parts.

I hope that helped you and didn't add extra confusion to those just getting started with PICs.

New Mini-Book

My new Mini-book titled "Programming PICs in BASIC" subtitle "8-pin Projects - Volume 1" is released and selling well. The book was written to use the CHIPAXE.com Breadboard Starter kit, which uses an 8-pin PIC12F683, PICkit 2 Clone Programmer and PICBASIC PRO sample version. In the book I show seven simple projects for the beginner including reading sensors, driving digital outputs and reading digital inputs. CHIPAXE.com has even created a complete starter kit with all the parts I used along with the book. This is how I suggested it should be used so beginners can get started easily. You can get just the book as well from my website for $14.95.

Conclusion

I received a lot of great feedback from the last newsletter. I especially appreciated the comments on where I should go next with my embedded C books. I'm working on that plan daily. If this newsletter inspires you to comment, good or bad, I'm always interested in your feedback so send me an email to chuck@elproducts.com.
Also want to welcome the new subscribers, the list is growing fast and I appreciate it.

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